Global Hydrology Resource Center

Data User Guide

Cloud Physics LiDAR (CPL) IMPACTS

Introduction

The Cloud Physics LiDAR (CPL) IMPACTS dataset consists of backscatter coefficient, lidar depolarization ratio, layer top/base height, layer type, particulate extinction coefficient, ice water content, and layer/cumulative optical depth data collected from the Cloud Physics LiDAR (CPL) onboard the NASA ER-2 high-altitude research aircraft in support of the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign. IMPACTS was a three-year sequence of winter season deployments conducted to study snowstorms over the U.S Atlantic Coast (2020-2022). The campaign aimed to (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. The dataset files are available in HDF-5 format from January 15 through March 2, 2020.

Notice: The ER-2 aircraft did not operate each day of the campaign, therefore, data are only available on flight days.

Citation

McGill, Matthew, Patrick Selmer, and John Yorks. 2020. Cloud Physics LiDAR (CPL) IMPACTS [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/IMPACTS/CPL/DATA101

Keywords:

NASA, GHRC, IMPACTS, CPL, backscatter coefficient, extinction profiles, depolarization ratio, layer optical depth, layer lidar ratio, aerosols

Campaign

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS), funded by NASA's Earth Venture program, is the first comprehensive study of East Coast snowstorms in 30 years. IMPACTS will fly a complementary suite of remote sensing and in-situ instruments for three 6-week deployments (2020-2022) on NASA's ER-2 high-altitude aircraft and P-3 cloud-sampling aircraft. The first deployment began on January 17, 2020 and ended on March 1, 2020. IMPACTS samples U.S. East Coast winter storms using advanced radar, LiDAR, and microwave radiometer remote sensing instruments on the ER-2 and state-of-the-art microphysics probes and dropsonde capabilities on the P-3, augmented by ground-based radar and rawinsonde data, multiple NASA and NOAA satellites (including GPM, GOES-16, and other polar orbiting satellite systems), and computer simulations. IMPACTS addressed three specific objectives: (1) Provide observations critical to understanding the mechanisms of snowband formation, organization, and evolution; (2) Examine how the microphysical characteristics and likely growth mechanisms of snow particles vary across snowbands; and (3) Improve snowfall remote sensing interpretation and modeling to significantly advance prediction capabilities. More information is available from NASA's Earth Science Project Office's IMPACTS field campaign webpage.

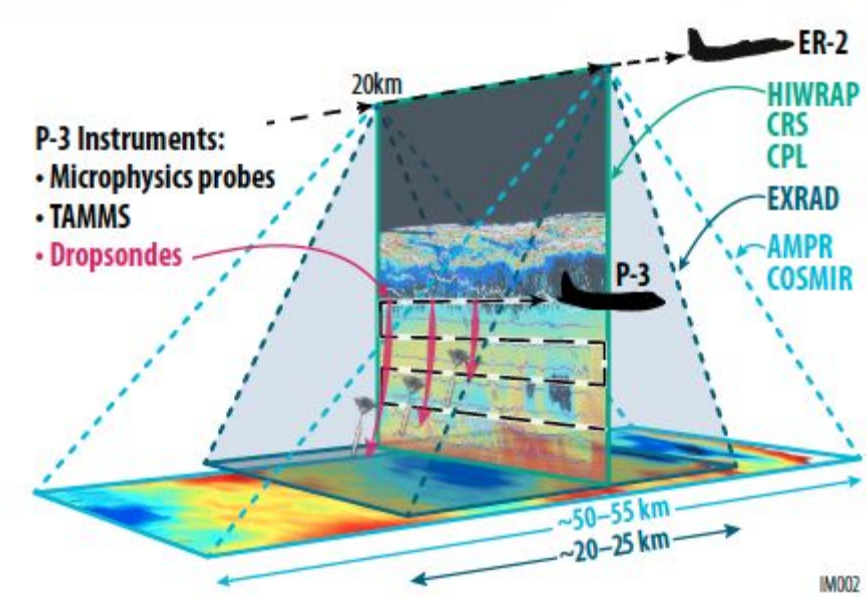

Figure 1: IMPACTS airborne instrument suite
(Image source: NASA IMPACTS ESPO)

Instrument Description

The Cloud Physics LiDAR (CPL) instrument (Figure 2) is a multi-wavelength backscatter LiDAR that provides high-resolution measurements of aerosols and cirrus clouds, enabling the study of their radiative and optical properties. The instrument was flown aboard

NASA's ER-2 high-altitude research aircraft during the IMPACTS field campaign. Light Detection and Ranging (LiDAR) is a remote-sensing technology in which a laser is used to gather 3-dimensional measurements of an object or environment. It works similarly to radar or sonar technology except that it uses light instead of radio or sound waves. LiDAR works by calculating the amount of time it takes the laser pulses to reach an object and return back to the scanner, allowing for spatial analysis. CPL uses three laser wavelengths (1064, 532, & 355 nm) that operate simultaneously. The instrument has the ability to detect visible and subvisible cirrus clouds and aerosols due to its laser's high pulse-repetition-frequency and low energy pulse, allowing for photon-counting detection. More information about CPL can be found on the NASA Airborne Science CPL webpage and in the CPL Data Applications document.

Figure 2: The CPL in aircraft configuration
(Image source: NASA Airborne Science CPL webpage)

Investigators

Matthew McGill
NASA GSFC
Greenbelt, MD

Patrick Selmer
NASA GSFC
Greenbelt, MD

John Yorks
NASA GSFC
Greenbelt, MD

Data Characteristics

The Cloud Physics LiDAR (CPL) IMPACTS dataset files contain backscatter coefficient, LiDAR depolarization ratio, layer top/base height, layer type, particulate extinction coefficient, ice water content, and layer/cumulative optical depth data. These data are available at a Level 1B and 2 processing level and stored in HDF-5 format. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA Earth Resources 2 (ER-2) aircraft
Instrument	Cloud Physics LiDAR (CPL)
Spatial Coverage	N: 44.760 , S: 32.517, E: -71.691, W: -117.230 (United States of America)
Spatial Resolution	L1B: Horizontal: ~200m at 20km flight altitude; Vertical: 30 m L2: Horizontal: 1km; Vertical: 30 m
Temporal Coverage	January 15, 2020 - March 2, 2020
Temporal Resolution	1 file per flight
Sampling Frequency	L1B: 1 second L2: 5 seconds
Parameter	Extinction profiles, layer optical depth, layer lidar ratio, aircraft parameters, aerosol layers, planetary boundary layer
Version	1
Processing Level	1B and 2

File Naming Convention

The Cloud Physics LiDAR (CPL) IMPACTS dataset files are stored in HDF-5 format and named using the following convention:

L1 Data files: IMPACTS_CPL_ATB_L1_YYYYMMDD.hdf5
L2 Data files: IMPACTS_CPL_L2_V1_-02_01km[Lay|Pro]_YYYYMMDD.hdf5

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
[Lay|Pro]	L2 data product type Lay: layer by layer product

	Pro: profile product
.hdf5	HDF-5 format

Data Format and Parameters

The Cloud Physics LiDAR (CPL) IMPACTS dataset files include backscatter coefficient, LiDAR depolarization ratio, layer top/base height, layer type, particulate extinction coefficient, ice water content and layer/cumulative optical depth data. Data products were produced for every wavelength, except the depolarization ratio which was only produced at 1,064 nm. The CPL data files are separated into two groups for the L1B and L2.

L1B CPL HDF-5 Files

The L1B HDF-5 files are calibrated attenuated backscatter (ATB) profiles and associated products. These files are produced at 1-second averages under normal conditions. The L1B data fields are listed in Table 3 below.

Table 3: L1B Data Fields

Field Name	Description	Data Type	Unit
ATB_1064	Attenuated total backscatter profile for 1064 nm for each record	double	$km^{-1}\ sr^{-1}$
ATB_1064_PERP	Attenuated Total Backscatter profile at 1064 nm perpendicular channel	double	$km^{-1}\ sr^{-1}$
ATB_355	Attenuated total backscatter profile for 355 nm for each record	double	$km^{-1}\ sr^{-1}$
ATB_532	Attenuated total backscatter profile for 532 nm for each record	double	$km^{-1}\ sr^{-1}$
Bin_Alt	Altitude for each vertical bin	float	km
Bin_Width	Vertical resolution of the lidar	float	m
Cali_1064	Calibration constant at 1064 nm for each record	double	km^3 / Js^2
Cali_1064_Err	Calibration error at 1064 nm	double	km^3 / Js^2
Cali_355	Calibration constant at 355 nm for each record	double	km^3 / Js^2
Cali_355_Err	Calibration error at 355 nm	double	km^3 / Js^2
Cali_532	Calibration constant at 532 nm for each record	double	km^3 / Js^2
Cali_532_Err	Calibration error at 532 nm	double	km^3 / Js^2
DEM_laserspot	Digital Elevation Model (DEM) value where the laser beam intersects the ground	float	m
DEM_laserspot_surftype	DEM coded surface type value where laser beam intersects the ground	int	-
DEM_nadir	DEM nadir value	float	m

DEM_nadir_surftype	DEM coded nadir surface type	int	-
Date	Date	-	-
Dec_JDay	Decimal day	double	-
EM	Energy monitor readings for each of the 3 wavelengths (355 nm, 532 nm, 1064 nm)	float	J
End_JDay	Decimal day at end of file	double	-
Frame_Top	Altitude at the bin at the top of the data profile	float	m
Hori_Res	Horizontal resolution	short	m
Hour	Hour when profile was collected	short	UTC
L1B_Version	Level 1B version	-	-
Latitude	Latitude	float	degrees
Longitude	Longitude	float	degrees
Minute	Minute	short	-
Mole_2way_Trans	Transmission of the signal due to molecular scattering accounting for transmit and return	double	-
Mole_Back	Rayleigh backscatter profile of first record, currently used for whole flight for all 3 wavelengths	double	$km^{-1}\ sr^{-1}$
NumBins	Number of vertical lidar bins in the optical profiles	short	-
NumChans	Total number of lidar channels, including annulus channels if available, whereas nchan=4 always	short	-
NumRecs	Number of horizontal records (profiles)	int	-
NumWave	Number of wavelengths in lidar output -- Wavelength (wl) index: 0=355, 1=532, 2=1064nm	short	-
Ozone_Transmission	Running transmission of ozone through the atmospheric column for each profile and wavelength	float	-
Plane_Alt	Height of the aircraft above mean sea level Missing = -999.0	float	km
Plane_Heading	Plane heading for current profile, clockwise from North	float	degrees
Plane_Roll	Aircraft roll, decimal degrees, left turn = '-'	float	degrees
Pressure	Atmospheric pressure profile of first record, currently used for whole flight float	float	hPa

Project	Field project name	char	-
RH	Atmospheric relative humidity profile of first record, currently used for whole flight	float	%
Saturate	Height where detector saturation occurred per channel No saturation = -5000.0	float	km
Second	Second of when profile was collected	short	UTC
Solar_Azimuth_Angle	Solar azimuth angle	float	degrees
Solar_Elevation_Angle	Solar elevation angle	float	degrees
Start_JDay	Decimal Julian day for the start time of the flight	double	UTC
Temperature	Atmospheric temperature profile of first record, currently used for whole flight	float	C
bg	Raw background signal at each wavelength	float	-

L2 CPL HDF-5 Files

The L2 HDF-5 files are organized into layer-by-layer products (*Lay_*.hdf5), described in Table 4, and profile products (*Pro_*.hdf5), described in Table 5. The L2 HDF-5 files are produced at 5-second averages under normal conditions and flag values for these data files are listed in Tables 6 - 8.

Table 4: L2 Layer by Layer Data Fields (*Lay_*.hdf5)

Group	Field Name	Data Type
geolocation	CPL_Angle	double
	CPL_Latitude	float
	CPL_Longitude	float
	Index_Top_Bin	short
	Solar_Azimuth_Angle	double
	Solar_Zenith_Angle	float
layer_descriptor	Aerosol_Type	short
	Cloud_Phase	short
	Cloud_Phase_Score	short
	Constrained_Lidar_Ratio_Flag	short
	DEM_Surface_Altitude	float
	Extinction_QC_Flag_1064	float
	Extinction_QC_Flag_355	float
	Extinction_QC_Flag_532	float

	Feature_Type	short
	Feature_Type_Score	short
	Layer_Base_Altitude	float
	Layer_Base_Bin	short
	Layer_Base_Pressure	float
	Layer_Base_Temperature	float
	Layer_Effective_Multiple_Scattering_Factor_1064	float
	Layer_Effective_Multiple_Scattering_Factor_355	float
	Layer_Effective_Multiple_Scattering_Factor_532	float
	Layer_Top_Altitude	float
	Layer_Top_Bin	short
	Layer_Top_Pressure	float
	Layer_Top_Temperature	float
	Lidar_Ratio_Selection_Method_1064	float
	Lidar_Ratio_Selection_Method_355	float
	Lidar_Ratio_Selection_Method_532	float
	Lidar_Surface_Altitude	float
	Number_Layers	short
	Opacity	ushort
	Profile_Decimal_Julian_Day	double
	Sky_Condition	short
	Surface_Type	short
metadata_parameters	Bin_Altitude_Array	float
	Bin_Size	float
	File_Start_DateTime	char
	File_Start_Latitude	float
	File_Start_Longitude	float
	File_Stop_Latitude	float
	File_Stop_Longitude	float
	File_Stop_Time	char
	File_Year	char
	Horizontal_Resolution	float
	Max_Number_Layers	short
	Number_1km_Profiles	int
	Number_Bins	int
	Product_Creation_Date	char
	Product_Version_Number	char
optical_properties	Attenuated_Backscatter_Statistics_1064	float
	Attenuated_Backscatter_Statistics_355	float
	Attenuated_Backscatter_Statistics_532	float
	Attenuated_Total_Color_Ratio_Statistics	float
	Feature_Optical_Depth_1064	float

	Feature_Optical_Depth_355	float
	Feature_Optical_Depth_532	float
	Feature_Optical_Depth_Uncertainty_1064	float
	Feature_Optical_Depth_Uncertainty_355	float
	Feature_Optical_Depth_Uncertainty_532	float
	Ice_Water_Path_1064	float
	Ice_Water_Path_1064_Uncertainty	float
	Ice_Water_Path_355	float
	Ice_Water_Path_355_Uncertainty	float
	Ice_Water_Path_532	float
	Ice_Water_Path_532_Uncertainty	float
	Integrated_Attenuated_Backscatter_1064*	float
	Integrated_Attenuated_Backscatter_355*	float
	Integrated_Attenuated_Backscatter_532*	float
	Integrated_Attenuated_Backscatter_Uncertainty_1064*	float
	Integrated_Attenuated_Backscatter_Uncertainty_355*	float
	Integrated_Attenuated_Backscatter_Uncertainty_532*	float
	Integrated_Attenuated_Total_Color_Ratio	float
	Integrated_Attenuated_Total_Color_Ratio_Uncertainty	float
	Integrated_Volume_Depolarization_Ratio_1064	float
	Integrated_Volume_Depolarization_Ratio_Uncertainty_1064	float
	Lidar_Ratio_1064	float
	Lidar_Ratio_355	float
	Lidar_Ratio_532	float
	Measured_Two_Way_Transmittance_1064	float
	Measured_Two_Way_Transmittance_355	float
	Measured_Two_Way_Transmittance_532	float
	Measured_Two_Way_Transmittance_Uncertainty_1064	float
	Measured_Two_Way_Transmittance_Uncertainty_355	float
	Measured_Two_Way_Transmittance_Uncertainty_532	float
	Two_Way_Transmittance_Measurement_Region	float
	Volume_Depolarization_Ratio_Statistics_1064	float

Table 5: L2 Profile Data Fields (*Pro_*.hdf5)

Group	Field Name	Data Type
geolocation	CPL_Angle	double
	CPL_Latitude	float
	CPL_Longitude	float
	Index_Top_Bin	short
	Solar_Azimuth_Angle	double

	Solar_Zenith_Angle	float
metadata_parameters	Bin_Altitude_Arra	float
	Bin_Size	float
	File_Start_DateTime	char
	File_Start_Latitude	float
	File_Start_Longitude	float
	File_Stop_Latitude	float
	File_Stop_Longitude	float
	File_Stop_Time	char
	File_Year	char
	Horizontal_Resolution	float
	Number_1km_Profiles	int
	Number_Bins	int
	Product_Creation_Date	char
	Product_Version_Number	char
profile	Aerosol_Optical_Depth_1064	float
	Aerosol_Optical_Depth_355	float
	Aerosol_Optical_Depth_532	float
	Aerosol_Optical_Depth_Uncertainty_1064	float
	Aerosol_Optical_Depth_Uncertainty_355	float
	Aerosol_Optical_Depth_Uncertainty_532	float
	Aerosol_Type	short
	Cloud_Optical_Depth_1064	float
	Cloud_Optical_Depth_355	float
	Cloud_Optical_Depth_532	float
	Cloud_Optical_Depth_Uncertainty_1064	float
	Cloud_Optical_Depth_Uncertainty_355	float
	Cloud_Optical_Depth_Uncertainty_532	float
	Cloud_Phase	short
	Cloud_Phase_Score	short
	Column_Optical_Depth_1064	float
	Column_Optical_Depth_355	float
	Column_Optical_Depth_532	float
	Column_Optical_Depth_Uncertainty_1064	float
	Column_Optical_Depth_Uncertainty_355	float
	Column_Optical_Depth_Uncertainty_532	float
	DEM_Surface_Altitude	float
	Extinction_Coefficient_1064	float
	Extinction_Coefficient_355	float
	Extinction_Coefficient_532	float
	Extinction_Coefficient_Uncertainty_1064	float
	Extinction_Coefficient_Uncertainty_355	float

	Extinction_Coefficient_Uncertainty_532	float
	Extinction_QC_Flag_1064	float
	Extinction_QC_Flag_355	float
	Extinction_QC_Flag_532	float
	Feature_Type	short
	Feature_Type_Score	short
	Ice_Water_Content_1064	float
	Ice_Water_Content_1064_Uncertainty	float
	Ice_Water_Content_355	float
	Ice_Water_Content_355_Uncertainty	float
	Ice_Water_Content_532	float
	Ice_Water_Content_532_Uncertainty	float
	Lidar_Surface_Altitude	float
	Mutiple_Scattering_Factor_1064	float
	Mutiple_Scattering_Factor_355	float
	Mutiple_Scattering_Factor_532	float
	Particulate_Backscatter_Coefficient_1064	float
	Particulate_Backscatter_Coefficient_355	float
	Particulate_Backscatter_Coefficient_532	float
	Particulate_Backscatter_Coefficient_Uncertainty_1064	float
	Particulate_Backscatter_Coefficient_Uncertainty_355	float
	Particulate_Backscatter_Coefficient_Uncertainty_532	float
	Profile_Decimal_Julian_Day	double
	Sky_Condition	short
	Surface_Type	short
	Total_Depolarization_Ratio_1064	float
	Total_Depolarization_Ratio_Uncertainty_1064	float

Table 6: CPL Optical Properties Flags

Parameter	Interpretation
Extinction_QC_Flag	-1 = calculation not attempted 0 = non-opaque layer extinction analysis nominal 1 = layer hit earth's surface before layer bottom reached, adjusted bottom 2 = lowering lidar ratio thru iteration process successful 3 = raising lidar ratio thru iteration process successful 4 = # of iterations maxed out, analysis stopped 5 = signal inside layer saturated before bottom, analysis stopped 6 =layer is opaque, layer OD=-1, initial lidar ratio accepted* 7 = layer is opaque, layer OD=-1, lidar ratio iteration successful*

	8 = layer OD out of bounder (invalid) OD= -999.9 9 = layer analysis invalid because final lidar ratio out of bounds
Lidar_Ratio_Selection_Method	0 = generic default 1 = aerosol GEOS5 lookup table 2 = cloud lookup table 3 = 1064 lidar ratio used 532 OD (for ice clouds only)* 4 = constrained result using clear zone just below layer 5 = constrained result with opaque layer 6 = lowered lidar ratio by a max of 15sr to reach layer bottom 7 = raised lidar ratio by a max of 15sr to reach layer bottom 8 = open slot (not used) 9 = missing
Constrained_Lidar_Ratio_Flag	0 = useful value using nominal “constrained” procedure 1 = useful value using opaque “constrained” procedure 2 = constrained lidar ratio outside thresholds 3 = below layer clear zone too small 4 = clear zone signal error > threshold 5 = Tp_sq < allowed min 6 = Tp_sq at or below 0.0 7 = useful 1064 lidar ratio using 532 OD (for ice clouds only)* 8 = Tp_sq at or below 0.0 in opaque cloud conditions 9 = missing

* Note: ‘OD’ stands for ‘Optical Depth’

Table 7: CPL Surface Type Flags

Parameter	Interpretation
IGBP_Surface_Type	1 = evergreen needleleaf forest 2 = evergreen broadleaf forest 3 = deciduous needleleaf forest 4 = deciduous broadleaf forest 5 = mixed forest 6 = closed shrubland 7 = open shrublands 8 = woody savannas 9 = savannas 10 = grasslands 11 = permanent wetlands 12 = croplands 13 = urban 14 = cropland/natural vegetation mosaic 15 = permanent snow and ice 16 = barren or sparsely vegetated 17 = water 18 = tundra

Table 8: CPL Vertical Feature Mask Parameters

Parameter	Interpretation
Sky_Condition	0 = clean skies (no clouds/aerosols) 1 = clear skies (no clouds) 2 = cloud skies (no aerosols) 3 = hazy/cloudy (both clouds/aerosols)
Feature_Type	0 = invalid 1 = cloud 2 = undetermined 3 = aerosol
Feature_Type_Score	| 10 | = high confidence | 1 | = low confidence 0 = zero confidence
Cloud_Phase	0 = invalid 1 = water cloud 2 = unknown cloud phase 3 = ice cloud
Cloud_Phase_Score	| 10 | = high confidence | 1 | = low confidence 0 = zero confidence
Aerosol_Type	0 = invalid 1 = marine 2 = polluted marine 3 = dust 4 = dust mixture 5 = clean/background 6 = polluted continental 7 = smoke 8 = volcanic

Algorithm

The CPL measures the backscatter coefficient, or the amount of signal reflected back to the instrument by the target. The rest of the signal is either absorbed by the target or scattered. Different layers can have different extinction-to-backscatter ratios (S-ratios), which is the total absorbed and scattered energy divided by the amount of backscattered energy, depending on the layer composition. Because of this, the processing algorithm must be able to discern aerosol types within each layer. More information about the processing algorithm is provided in McGill et al. (2002) and McGill, Hlavka, Hart, Welton, and Campbell (2003).

Quality Assessment

The CPL data processing algorithm calibrates each CPL measured profile by matching it to

the profile of a calibration region, free of clouds and aerosols. Since the CPL instrument is a nadir-viewing system in the lower stratosphere, the altitude regime used for calibration is in the upper troposphere. After the calibrated 1-second averaged profiles are produced, they are averaged again to a 5-minute resolution. The 5-minute averaged profile data are fit to a curve to produce a polynomial calibration equation for each wavelength. More information about the CPL data calibration process can be found in McGill et al. (2003) and Vaughan, Liu, McGill, Hu, and Obland (2010).

Software

These data are available in HDF-5 formats. No special software is required to view these data, however, Panoply can be used to easily view the HDF-5 data.

Known Issues or Missing Data

The ER-2 aircraft did not operate each day of the campaign, therefore, data are only available on flight days.

References

McGill, M.J., Hlavka, D.L., Hart, W., Scott, V.S., Spinhirne, J., & Schmid, B. (2002). Cloud Physics Lidar: instrument description and initial measurement results. *Applied Optics*, *41(18)*, 3725-3734. https://doi.org/10.1364/AO.41.003725

McGill, M.J., Hlavka, D.L., Hart, W.D., Welton, E.J., & Campbell, J.R. (2003). Airborne lidar measurements of aerosol optical properties during SAFARI-2000. *Journal of Geophysical Research*, *108(D13)*, 29-1 - 29-12. https://doi.org/10.1029/2002JD002370

McGill, M.J., Hlavka, D.L., & Hart, W.D. (2005). Applications of Data from the Cloud Physics Lidar. 2nd Symposium on Lidar. https://ams.confex.com/ams/pdfpapers/85877.pdf

McGill, M.J., Vaughan, M.A., Trepte, C.R., Hart, W.D., Hlavka, D.L., Winker, D.M., & Kuehn, R. (2007). Airborne validation of spatial properties measured by the CALIPSO lidar. *Journal of Geophysical Research*, *112*, 1-8. http://dx.doi.org/10.1029/2007JD008768

NASA. (2017). NASA Armstrong Fact Sheet: ER-2 High-Altitude Airborne Science Aircraft. https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-046-DFRC.html

Vaughan, M.A., Liu, Z., McGill, M.J., Hu, Y., & Obland, M.D. (2010). On the spectral dependence of backscatter from cirrus clouds: Assessing CALIOP's 1064 nm calibration assumptions using cloud physics lidar measurements. *Journal of Geophysical Research*, *115(D14206)*, 1-17. https://doi.org/10.1029/2009JD013086

Related Data

All other datasets collected as part of the IMPACTS campaign are considered related and can be located by searching the term “IMPACTS'' in the GHRC HyDRO2.0 search tool. CPL datasets from other field campaigns can be located by searching “CPL” in HyDRO2.0 and are listed below.

GOES-R PLT Cloud Physics Lidar (CPL)
(http://dx.doi.org/10.5067/GOESRPLT/CPL/DATA101)

GPM Ground Validation Cloud Physics Lidar (CPL) OLYMPEX
(http://dx.doi.org/10.5067/GPMGV/OLYMPEX/CPL/DATA101)

Hurricane and Severe Storm Sentinel (HS3) Global Hawk Cloud Physics Lidar (CPL)
(http://dx.doi.org/10.5067/HS3/CPL/DATA202)

Contact Information

To order these data or for further information, please contact:

NASA Global Hydrology Resource Center DAAC
User Services
320 Sparkman Drive
Huntsville, AL 35805
Phone: 256-961-7932
E-mail: support-ghrc@earthdata.nasa.gov
Web: https://ghrc.nsstc.nasa.gov/

Created: 10/07/2020